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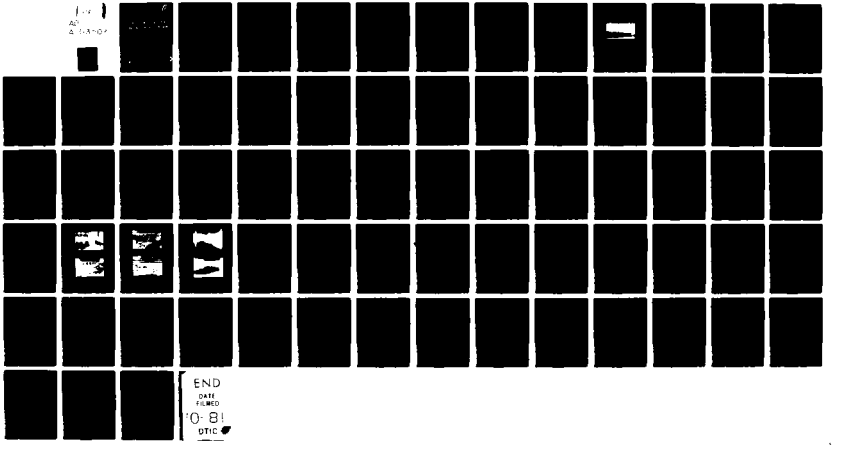

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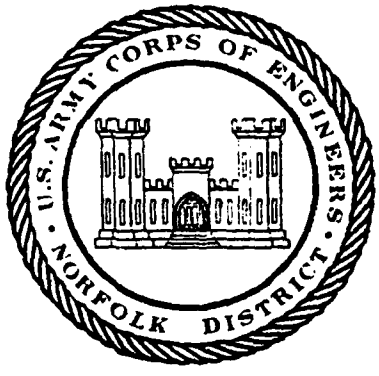
Name Of Dam: UNIVERSITY COMMONS DAM

Location: RICHMOND, VIRGINIA

Inventory Number: VA. NO. 76008

LEVEL II

PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

BY

SCHNABEL ENGINEERING ASSOCIATES, P.C./
J. K. TIMMONS AND ASSOCIATES, INC.

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Inspection is to indentify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspection. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam appurtenenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

JAMES RIVER BASIN

NAME OF DAM: UNIVERSITY COMMONS DAM
LOCATION: RICHMOND, VIRGINIA
INVENTORY NUMBER: VA. NO. 76008

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED FOR
NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

BY

SCHNABEL ENGINEERING ASSOCIATES, P.C./
J. K. TIMMONS AND ASSOCIATES, INC.

FEBRUARY, 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

BRIEF ASSESSMENT OF DAM

Name of Dam:	University Commons Dam
State:	Virginia
Location:	City of Richmond
USGS QUAD Sheet:	Bon Air, Virginia
Coordinates:	Lat 37° 34.5' Long 77° 32.3'
Date of Inspection:	November 17, 1980

University Commons Dam is a zoned earthfill structure about 300 ft long and 24 ft high. The spillway consists of an ogee shaped, concrete overflow spillway, which extends 264 ft across the dam. The dam is a small size structure and is assigned a high hazard classification. The dam is located on Little Westhampton Creek, on the Campus of the University of Richmond in the City of Richmond, Virginia. The lake is used for recreation and is owned and maintained by the University of Richmond.

The University Commons Dam spillway runs under the University Commons Building with a 6 ft clearance. The spillway abutments are part of the building foundation, and the building comprises the balance of the dam length beyond the spillway.

Based on the criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the appropriate Spillway Design Flood (SDF) is the ½ PMF. The spillway will pass 75 percent of the Probable Maximum Flood (PMF) or 150 percent of the SDF without reaching the masonry overhang of the University Commons Building. The spillway is rated adequate.

The visual inspection did not reveal any problems which would require immediate attention. The dam is considered stable and a stability analysis is not required. An emergency operation and warning plan should be developed. It is recommended that all existing cracks and seepage be monitored. Furthermore a staff gage should be installed to monitor water levels.

Prepared by:

SCHNABEL ENGINEERING ASSOCIATES, P.C./
J. K. TIMMONS & ASSOCIATES, INC.

Ray E. Martin, Ph.D., P.E.
Commonwealth of Virginia

Submitted by:

ORIGINAL SIGNED BY:
JAMES A. WALSH

James A. Walsh, P.E.
Chief, Design Branch

Approved:

Original signed by:
Douglas L. Haller

Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

Recommended by:

ORIGINAL SIGNED BY:
JACK G. STARR

Jack G. Starr, P.E.
Chief, Engineering Division

Date: MAR 11 1981

Reservoir and Commons Building

Overview Photograph

SECTION 1 - PROJECT INFORMATION

1.1 General:

1.1.1 Authority: Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspection of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (Reference 1, Appendix V). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Project Description:

1.2.1 Dam and Appurtenances: University Commons Dam is a zoned earthfill structure approximately 300 ft long and 24 ft high* with a spillway length of 264 ft. The crest of the spillway and dam is 62 ft wide. The upstream slope is approximately 3 horizontal to 1 vertical (3:1) and is covered with a minimum 2.0 ft thick impervious blanket from the upstream end of the crest to 50 ft beyond the upstream toe.

The downstream slope is 1 horizontal to 1 vertical (1:1) to El 128 for the width of the overflow spillway. Below El 128 the downstream slope tapers off to about a 17 horizontal to 1 vertical slope (17:1) for the length of the discharge channel, which comprises the remainder of the downstream embankment. Design drawings indicated the embankment

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* Height is measured from the downstream invert of the outlet pipe to the roadway crest at the left abutment. The road crest elevation corresponds to the overhang of the building over the spillway.

is keyed into rock (Plate 5, Appendix I) and field soils testing reports indicate a cutoff trench was excavated.

The University Commons building was constructed over the dam crest and is supported on deep piers within the dam which are situated on spread footings supported on rock. The 264 ft spillway runs under the building with the building comprising the balance of the dam length beyond the spillway to the left abutment. The abutments are part of the building foundation. (see Plate 2, Appendix I)

The crest, spillway and upper section of the spillway apron are bordered by retaining walls. The right retaining wall, Wall 'A', is considered a part of the right abutment while the left abutment is approximately 36 ft beyond the left retaining wall, Wall 'B'. (see Plate 4, 7 & 8, Appendix I)

The dam consists of a 264 ft wide channel beneath the building discharging over a 264 ft wide ogee shaped concrete spillway (see Plate Nos. 2 and 5, Appendix I, and Photo No. 2, Appendix II). The spillway is an earth structure with a reinforced concrete membrane over the approach and spillover areas. The spillway is followed by a concrete outlet channel which converges from a 264 ft width to a 70 ft width downstream of the spillway. There is a 3½ inch deep by 4 ft wide low flow channel located in the geometric center of the spillway. There is 6 ft of clearance between the spillway crest and the bottom outside edge of the building. (see Plate No. 2, Appendix I)

A foundation drainage system was not included in design of this dam based on the design drawings reviewed. However, drainage tile was installed behind the retaining walls. (see Plate 8, Appendix I)

1.2.2 Location: University Commons Dam is located on Little Westhampton Creek on the Campus of the University of Richmond in the City of Richmond, Virginia. (see Plate No. 1, Appendix I)

1.2.3 Size Classification: The dam is classified as a "small" size structure because of the lake maximum storage potential.

1.2.4 Hazard Classification: The dam is located in an urban area, and based upon the interconnecting of the building and the dam, and the proximity of warehouses, a power plant, and construction offices within a quarter mile downstream, the dam is assigned a high hazard classification. The hazard classification used to categorize a dam is a function of location only, and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: The dam is owned by the University of Richmond.

1.2.6 Purpose: Recreation.

1.2.7 Design and Construction History: The dam was designed by Caudill, Rowlett and Scott, Houston, Texas and Rawlings and Wilson, Richmond, Virginia and constructed under the supervision of C. M. Associates, Inc., Houston, Texas. The dam was constructed by the W. S. Cordle Construction Company of Emporia, Virginia and completed in 1975.

1.2.8 Normal Operational Procedures: The spillway is ungated; therefore, water rising above the crest of the low flow channel and the spillway crest is automatically discharged downstream. Normal pool is maintained at about elevation 138 msl.

1.3 Pertinent Data:

1.3.1 Drainage Area: The drainage area is 2.65 square miles, which is a completely developed residential area.

1.3.2 Discharge at Dam Site: According to Mr. Warden G. Farmer, the maximum known flood at the dam site occurred in October, 1979, with a maximum pool elevation of approximately 140 msl, which corresponds to a 2500 CFS discharge.

Principal Spillway Discharge:

Pool Elevation at low wall of building (elev 144 msl) 13,537 CFS

1.3.3 Dam and Reservoir Data: See table 1.1, below:

TABLE 1.1 - DAM AND RESERVOIR DATA

	Reservoir				
			Storage		
Item	Elevation Feet msl	Area Acres	Volume Acre Feet	Watershed Inches	Length Miles
Low Wall of Building	144	23	267	1.94	.4
Principal Spillway Crest	138	13.7	143	1.04	.3
Streambed at Down-Stream Toe of Dam	120	-	-	-	-

SECTION 2 - ENGINEERING DATA

2.1 Design: The dam was designed under the direction of Caudill, Rowlett and Scott, Houston, Texas, and Rawlings and Wilson, Richmond, Virginia. Construction of the facility was managed by CM Associates, Houston, Texas.

Existing on this site prior to the construction of the Commons Dam was an earth fill embankment approximately 22 ft high with a road crossing the crest. An overflow spillway crossed by a bridge existed in the embankment. No other details were available for this previous embankment.

A subsurface investigation was conducted at the site by Sayre and Sutherland, Inc., Richmond, Virginia during the design phase of the project. The purpose of the investigation was to determine the subsurface soil and rock conditions for the new dam and spillway and the foundations for the proposed structure to be built above the dam. Test boring logs and locations are included in Appendix IV.

The dam was designed as a zoned, compacted earth fill embankment with a reinforced concrete membrane on the crest, spillway and spillway discharge area (or apron), and a compacted clay core with side slopes of 1H:2V. The upstream slope was to be covered with a minimum 2 ft thick impervious blanket (Plate 4, Appendix I). Construction specifications required that the "impervious material" required for the core of the dam and the upstream slope be a "cohesive soil or inorganic clay; obtained from excavation or borrow areas and shall be approved by the Architect-Engineer prior to construction of the embankment." The "pervious material" used for embankment fill was to be

"cohesionless soil or granular soil, obtained from on-site excavation and/or borrow areas, which shall be approved by the Architect-Engineer prior to construction of the embankment." Compaction of the impervious material was to be 98 percent of Modified Proctor maximum dry density at optimum moisture content as determined by ASTM D-1557. Moisture content of this material was to be controlled within plus or minus 3 percent of optimum. Compacted lift thicknesses were not to exceed 6 inches for the impervious material. The pervious material was to be compacted to a "relative density" of "not less than 90 percent as determined by ASTM D-1557." Allowable compacted lift thicknesses could vary from 6 to 12 inches depending on the type of compaction equipment used.

It was recommended in the subsurface investigation report that the soil in the existing dam not be used as fill in the new dam. It was suggested that material for the embankment be obtained from other construction sites at the university and from off-campus borrow areas.

The design data indicates that the dam is founded on Petersburg Granite and that the weathered rock was to be removed. The limits of excavation to bedrock indicated in the design details are approximately 71 ft downstream and 76 ft upstream from the center line of the dam. The areas of the dam not founded on bedrock include the downstream slope below the lake drain valve manhole and the upstream slope beyond the lake drain intake (Plate 4, Appendix I). No field permeability test data was included in the design data reviewed. A 5 ft wide cutoff trench excavated 2 ft into rock was also planned. Details of the cut-off trench and clay core are provided on Plate 5, Appendix I.

No internal drainage system was provided for this structure based on the design drawings reviewed. A 24 inch diameter transite pipe was constructed through the dam as a lake drain. No anti-seep collars were shown on the design drawings. Details of the lake drain system are shown on Plate No. 6, Appendix I.

The spillway was designed as an overflow structure consisting of a concrete weir at the crest and a reinforced concrete membrane over an earthfill. The overflow structure discharges onto a spillover area or apron and into a converging outlet channel. Both of these structures are protected by a reinforced concrete membrane and their total length is approximately 167 ft. The crest, spillway and upper section of the spillway apron are bordered by a retaining wall on the right as the right retaining wall is part of the right abutment. The left abutment is approximately 36 ft beyond the left retaining wall, Wall "B." Details of the walls are shown on Plates Nos. 7 and 8 in Appendix I.

No stability analysis information was made available for this inspection.

2.2 Construction: The dam was constructed by the W. S. Cordle Construction Company of Emporia, Virginia under the supervision of C. M. Associates, Inc., Houston, Texas. The only construction records available for this structure were field density test reports by Penniman and Brown, Inc., Richmond, Virginia, a firm contracted to perform the soils testing. Prior to construction of the present facility, the removal of an earthfill dam and bridge over the spillway structure was required.

2.3 Evaluation: Design drawings are representative of the structure, however, hydrologic and hydraulic calculations were not available for evaluation. There is sufficient information to evaluate foundation conditions but not the embankment stability.

SECTION 3 - VISUAL INSPECTION

3.1 Findings: At the time of inspection, the dam was in good condition. Field observations are outlined in Appendix III.

3.1.1 General: An inspection was made on November 17, 1980 and the weather was rainy with a temperature of 46°F. The pool and tailwater levels at the time of inspection were 137.75 and 120 msl, respectively, which corresponds to normal pool and tailwater elevations. Ground conditions were wet at the time of inspection. No previous inspection reports were available.

3.1.2 Dam and Spillway: The upstream slope of the embankment was submerged and not observed. The dam crest or spillway approach was covered with a reinforced concrete membrane and submerged. The downstream slope is made up of the spillway, spillover area and discharge channel. These areas are covered with a reinforced concrete membrane. Vertical hairline cracks in the concrete membrane on the spillway section (1H:1V slope) were observed. Horizontal hairline cracks in the concrete along the crest of the spillway were also observed. No other signs of deterioration such as spalling or peeling of concrete at the concrete spillway, approach channel, discharge channel and lake drain pipe were observed. These structures were functioning properly at the time of inspection. (See Photos, Appendix II).

Geologic conditions in the abutment areas could not be observed because of the existing structure and associated retaining walls. The walls were observed to be in good condition and no water was noted coming

from the subdrains behind the walls. Fill material behind the retaining walls appeared to be clayey silt (ML) and silty sand (SM) with several large granite boulders protruding from the slopes. The upstream area of the abutments were grass covered and in good condition. Surface soils in this area consisted of clayey silts (ML) and silty sands (SM).

Some discoloration and seepage (less than 1 gpm) was noted in the vicinity of the construction joints in the discharge channel concrete membrane approximately 80 ft downstream of the spillway (see Field Sketch, Appendix III, Sheet 1).

There was evidence of past erosion at the lower end of the outlet channel where the earth channel and natural channel slopes begin. The erosion had been repaired with broken concrete rip rap.

3.1.3 Reservoir Area: The reservoir area was free of debris and the perimeter was wooded on the right side and grassed on the left side (Overview Photograph, Page 3). The reservoir is located in a natural valley with side slopes at approximately 2H:1V on the right side and 4H:1V on the left side. No sediment build-up was observed.

3.1.4 Downstream Area: The downstream channel is located in a flood plain with 10H:1V side slopes above the channel banks (Photograph No. 4 , Appendix II). The channel is approximately 8 ft deep with 1H:1V side slopes pre-existing from the old dam. Approximately 100 ft below the outlet channel is the University Power Plant; approximately 500 ft downstream are two bridges, a construction office and a warehouse facility; approximately one-half mile downstream a commercial bank was constructed over the stream.

3.1.5 Instrumentation: No instrumentation (monuments, observation wells, piezometers, etc.) was encountered for the structure. A staff gage was not observed.

3.2 Evaluation: Overall, the dam was in good condition at the time of the inspection.

3.2.1 Dam and Spillway: The vegetative cover on the upstream abutments appeared to be well maintained. The concrete membrane on the downstream slope was in good condition with the exception of some shrinkage cracks which have occurred in the spillway and outlet channel concrete membrane. The observed seepage in the discharge channel is minor and does not inhibit the proper functioning of the dam. The spillway is functioning well. A staff gage should be installed to monitor water levels.

3.2.2 Downstream Area: A breach in the University Commons Dam during extreme flooding could create a hazard to the downstream facilities.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: University Commons Dam is used for recreational purposes. The normal pool elevation (about 137.75 msl) is maintained by a low flow notch in the spillway. Water automatically flows over the spillway crest as the pool level rises above elevation 137.7 msl.

4.2 Maintenance of Dam and Appurtenances: Maintenance is the responsibility of the Owner. Maintenance consists of routine inspection and the removal of debris, mowing of vegetative cover, and repair as required. Routine maintenance is performed.

4.3 Warning System: At the present time there is no warning system or evacuation plan for the dam.

4.4 Evaluation: The dam and appurtenances are in good operating condition, and maintenance of the dam is adequate. Records should be maintained of all maintenance and operational procedures for future reference. An emergency operation and warning plan should be developed. It is recommended that a formal emergency procedure be prepared and furnished to all operating personnel. This should include:

a) How to operate the dam during an emergency.

b) Who to notify, including public officials, in case evaluation from the downstream area is necessary.

SECTION 5 - HYDRAULICS/HYDROLOGIC DATA

5.1 Design: University Commons Dam was designed as a single-purpose dam. Hydrologic and hydraulic data was not available for evaluation.

5.2 Hydrologic Records: There are no records available.

5.3 Flood Experience: According to Mr. Farmer, a maximum pool elevation of 140^{+} msl occurred in October, 1979.

5.4 Flood Potential: In accordance with the established guidelines, the Spillway Design Flood (SDF) is based on the estimated "Probable Maximum Flood" (flood discharges that may be expected from the most severe combination of critical meterologic and hydrologic conditions that are reasonably possible in the region), or fractions thereof. The Probable Maximum Flood (PMF), ½ PMF and 100 year hydrographs for the local area were developed by the HEC-1 method (Reference 5, Appendix V). Precipitation amounts for the flood hydrographs of the PMF and 100 year flood were taken from U. S. Weather Bureau Information (References 6 and 7, Appendix V). Appropriate adjustments for basin size and shape were accounted for. The inflow hydrographs for each rainfall occurrence were routed through the reservoir to determine maximum pool elevations.

5.5 Reservoir Regulations: For routing purposes, the pool at the beginning of flood was assumed to be at elevation 138 msl. Reservoir stage-storage data and stage-discharge data were determined from the construction plans and available topographic data (USGS quadrangle Sheet). Floods were routed through the reservoir using the spillway discharge only.

5.6 Overtopping Potential: The predicted rise of the reservoir pool and other pertinent data were determined by routing the flood hydrographs through the reservoir as previously described. The results for the flood conditions for the PMF, ½ PMF and 100 year flood are shown in the following Table 5.1:

TABLE 5.1 - RESERVOIR PERFORMANCE

		Hydrograph		
	Normal Flow	100 Year	½ PMF	PMF
Peak Flow, CFS				
Inflow	3	3038	7997	15,994
Outflow	3	2859	7615	15,457
Maximum Pool* Elevation Ft, msl	138	140.13	142.10	144.57
Tailwater Elevation Ft, msl	120	126.6	130.6	134.5

5.7 Reservoir Emptying Potential: A 24 inch diameter gate at centerline elevation 121.5 msl is capable of draining the reservoir. Assuming that the lake is at normal pool elevation (138 msl) and there is 3 cfs inflow, it would take approximately three days to lower the reservoir to elevation 121.5 msl, or a 5.5 ft per day drawdown rate.

* Velocities in approach channel under the University Commons Building during the PMF equal 7 ft per second which is not considered detrimental to either the concrete spillway or masonry substructure of the building. Velocities over the spillway during the PMF equal 12.3 ft per second at critical depth and 9.7 ft per second during ½ PMF.

5.8 Evaluation: The U. S. Army, Corps of Engineers' guidelines indicate the appropriate Spillway Design Flood (SDF) for a small size, high hazard dam is the ½ PMF to PMF. Because of the risk involved, the ½ PMF has been selected as the SDF. The spillway will pass 75 percent of the PMF (150 percent of the SDF) without reaching the masonry overhang of the Commons Building.

Hydrologic data used in the evaluation pertains to present day conditions with no consideration given to future development.

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: The dam is located along the eastern edge of the Piedmont physiographic province of Virginia. The site is underlain by residual soils derived from the in-place weathering of Petersburg Granite of Paleozoic geologic age. These residual soils typically consist of micaceous sands and silts throughout the Richmond area. The Petersburg Granite consists of fine to coarse grained, foliated to nonfoliated granite, but also includes granodiorite and minor amounts of quartz mazonite. Test borings indicate that the bedrock becomes less weathered with depth. The bedrock is generally slightly to moderately jointed and fractured. Available geologic maps indicate that local bedrock joints strike from the northwest to northeast and dip from 70 to 86 degrees. These maps do not indicate the presence of any faults in the site vicinity.

Design drawings indicated the embankment was to be founded on bedrock with a cutoff trench keyed into the bedrock below the impervious core. However, it was concluded in the foundation report that it would "not be necessary" to embed the cutoff wall in rock . . . because the fractures and joints in the rock are tight and would carry very little water under the relatively low head conditions of this project." At the time of this inspection, information from field soils reports indicated a cutoff trench in rock probably was excavated.

Gradual consolidation of underlying materials would not be expected during application of fill materials as the highest portions of the embankment were founded on rock. Based upon the performance

history of this dam and the test boring data, a stable foundation is assumed.

6.2 Embankment:

6.2.1 Materials: Design drawings show the dam as a zoned embankment with Zone I as an impervious core and impervious upstream blanket. Zone I was constructed with silty clay (CH) and possibly micaceous silt (MH) materials as indicated in available construction records. No information was available on the material used in construction of the pervious, Zone II of the embankment. However, borrow material tested for use in this zone was a silty sand (SM) material. Soils in the impervious zone were to be compacted to 98 percent of Modified Proctor maximum dry density (ASTM D-1557) and within plus or minus 3% of optimum moisture content with compacted lift thicknesses not to exceed 6 inches. Materials used in the pervious zones were to be compacted to 90 percent of Modified Proctor maximum dry density (ASTM D-1557). The maximum compacted lift thickness was not to exceed 6 inches if compaction was performed by tampers or rollers and not more than 12 inches if compaction was performed by treads of crawler-type tractors, surface vibrators, or similar equipment, and not more than the penetrating depth of the vibrator if compaction was performed by internal vibrators.

6.2.2 Subdrains and Seepage: No special foundation treatment was utilized during the construction of the embankment. A cutoff trench was to be excavated into the bedrock along the centerline of the core as shown on the design drawings (Plate Nos. 4 and 5, Appendix I). According to inspection reports filed during construction, a spring existed in the rock cutoff trench. In an attempt to control the flow

of water from the spring, a 3 ft lift of the impervious material was placed in the trench as a working mat. It was noted in the inspection reports that the seepage from the spring continued. No additional action was noted in the available construction records.

A lake drainage system utilizing a 24 inch transite pipe extending through the embankment was illustrated on the drawing. No anti-seep collars were indicated in the design. The drain is operated by a valve located on the discharge channel. Details of the drainage system and cutoff are provided on Plates 4, 5 and 6 of Appendix I.

Plate 8, Appendix I shows subdrains installed behind retaining walls A and B. The drains are outside the embankment, however, it is not know whether they are sealed off from the embankment.

Some seepage was observed coming from several construction joints in the concrete discharge channel area approximately 80 ft below the spillway. The concrete was slightly stained indicating possible seepage through the embankment.

6.2.3 Stability: It is not known if a stability analysis was performed for this structure and there was no information available for this inspection. The dam is 24 ft high and has a crest width of approximately 62 ft. A clearance of 6 ft exists between the top of the overflow weir, El 138 and the bottom of the building. The upstream slope is 3H:1V with a 2 ft thick impervious blanket on the upstream face from 50 ft beyond the upstream toe to the crest of the embankment at El 136. The overflow section of the spillway is sloped at 1H:1V from El 138 to El 128 then nearly flat along the spillover section for about 27 ft. The slope continues on about a 17H:1V slope over the remainder of the embankment which constitutes the concrete discharge channel. The concrete discharge channel extends to the stream channel at El 120,

approximately 140 ft from the spillover area.

The dam was designed as a zoned earth embankment and constructed with the materials indicated in Section 6.2.1. Therefore, the stability is assessed assuming a zoned earth dam. The dam is subjected to sudden drawdown because the approximate reservoir drawdown rate of 5.5 ft per day exceeds the critical rate of 0.5 ft per day for earth dams. According to the guidelines presented in Design of Small Dams, U. S. Department of the Interior, Bureau of Reclamation for small zoned dams, with stable foundation, subjected to a drawdown and with core material composed of MH to CH materials, the recommended slopes are 2H:1V upstream and 2H:1V downstream. The recommended crest width is 13.6 ft. Based on these general guidelines, the upstream embankment slopes and crest width are adequate. However, the upper portion of the downstream slope is steep at 1H:1V and does not meet the recommended guidelines.

6.2.4 Seismic Stability: The dam is located in Seismic Zone 2. Therefore, according to the Recommended Guidelines for Safety Inspection of Dams, the dam is considered to have no hazard from earthquakes provided static stability conditions are satisfactory and conventional safety margins exist.

6.3 Evaluation: An accurate check on the stability of this structure cannot be made since there was no stability analysis available. Based upon the visual inspection and the design drawings the foundation is considered stable and a stability analysis is not required. According to general Bureau of Reclamation guidelines, the upstream slope and embankment crest width are adequate, but the downstream slope is inadequate. However, based upon the low

height of the dam and a crest width that is approximately 5 times greater than required, it is our opinion that the steep downstream slope does not create a stability problem. Furthermore, the steep slope begins to flatten to 17H:1V 10 ft below the crest. The concrete membrane on the crest and downstream slope is not assumed to contribute to the stability, but it is a significant factor in slope protection. A condition whereby the pool level would reach the masonry overhang of the Commons Building is not a problem as the spillway will pass 75 percent of the PMF (150 percent of the SDF). No undue settlement, cracking or sloughing was noted at the time of inspection. The seepage observed from several construction joints in the concrete discharge channel may be from the spring previously described in the key trench. With the low head conditions and concrete membrance, this seepage is not considered to be a serious erosion problem. It appears that the embankment is adequate for maximum control storage with water at elevation 138 msl.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: University Commons Dam at the time of inspection appeared to be in good condition. The appropriate SDF for this dam is the ½ PMF. The spillway will pass 75 percent of the PMF (150 percent of the SDF) without reaching the masonry overhang of the Commons Building. The spillway is judged adequate.

The visual inspection revealed no findings that proved the dam to be unsound, therefore, a stability check is not required. A routine maintenance program exists for the structure and maintenance is considered adequate. At the present time, there is no warning system or evacuation plan for the dam.

7.2 Recommended Remedial Measures:

7.2.1 Emergency Operation and Warning Plan: It is recommended that a formal emergency procedure be prepared, prominently displayed, and furnished to all operating personnel. This should include:

1) How to operate the dam during an emergency.

2) Who to notify, including public officials, in case evacuation from the downstream is necessary.

7.3 Required Maintenance:

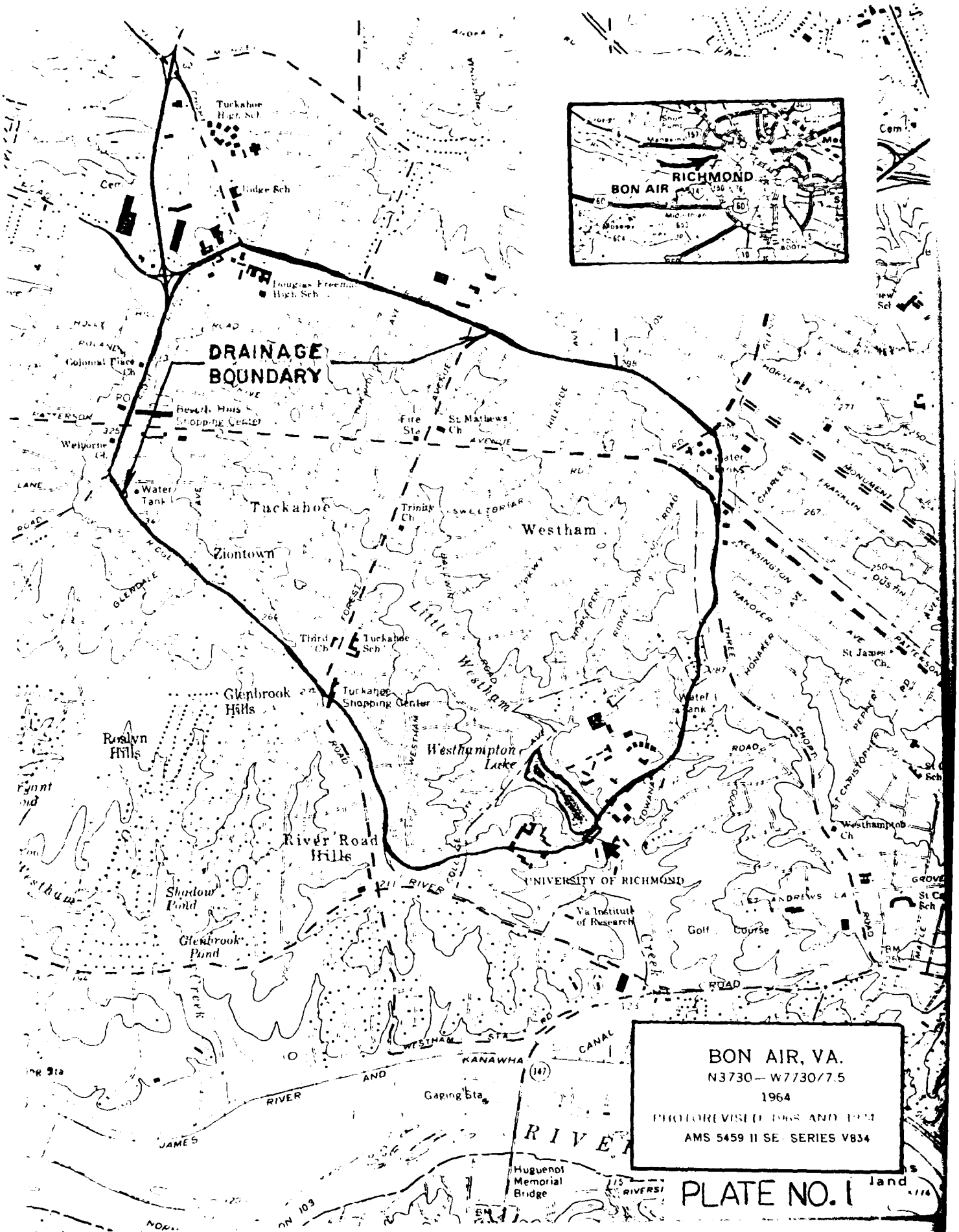
7.3.1 A staff gage should be installed to monitor water levels.

7.3.2 The seepage from the discharge channel concrete membrane should be monitored. If any increase in seepage flow rates are observed, a professional Geotechnical Engineer should be contacted to evaluate the problem and make recommendations for required corrective measures.

7.3.3 The hairline cracks on the spillway and discharge concrete membrane should be monitored. If any increase in the number or width of cracks is observed, a professional Geotechnical Engineer should be contacted to evaluate the problem and make recommendations for required corrective measures.

APPENDIX I

MAPS AND DRAWINGS



BON AIR, VA.
N3730—W7730/7.5
1964
PHOTOREVISED 1985 AND 1994
AMS 5459 II SE-SERIES V834

PLATE NO. 1

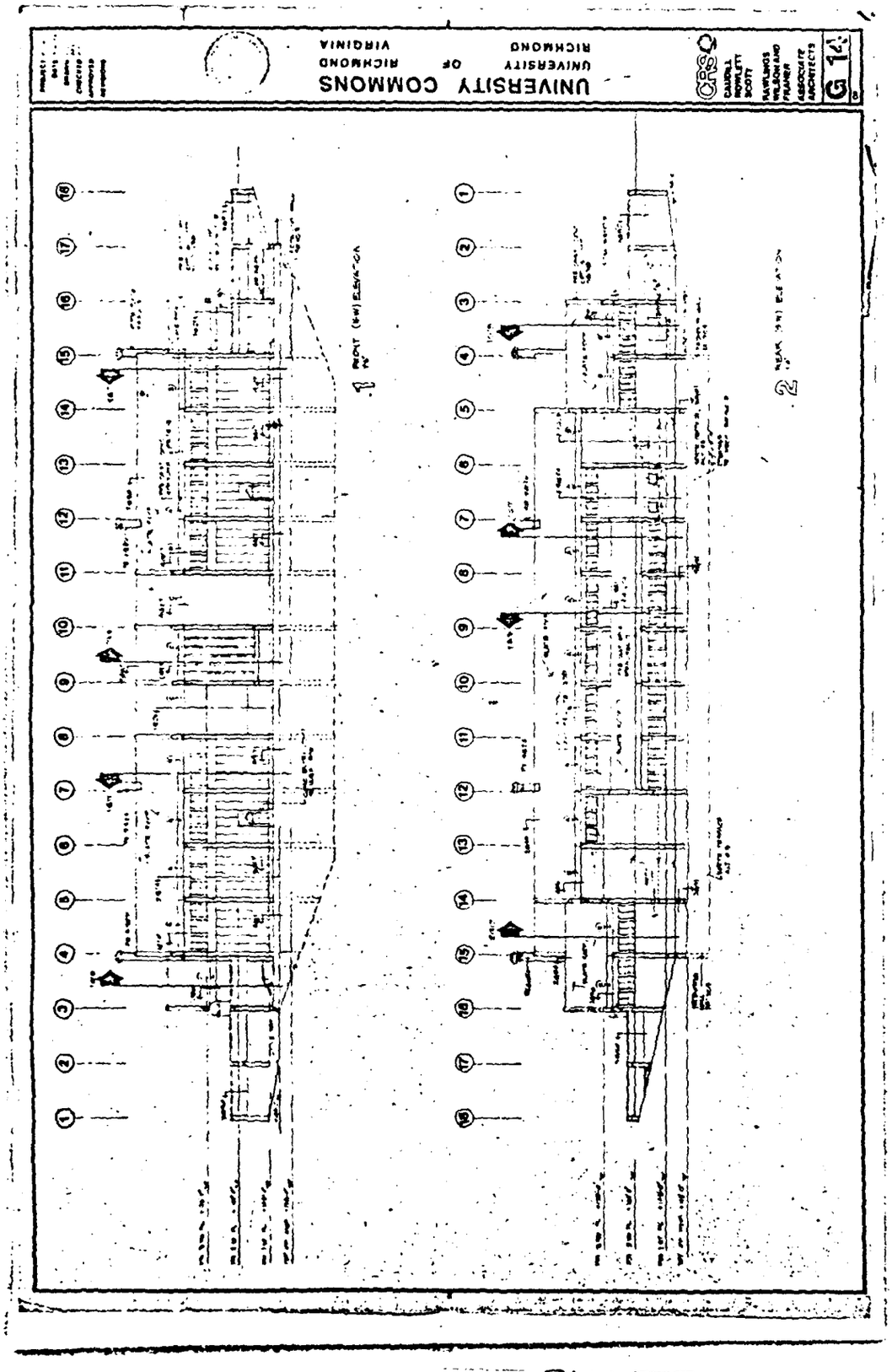

UNIVERSITY COMMONS
UNIVERSITY OF RICHMOND
RICHMOND VIRGINIA
CARROLL HOPKETT SCOTT
RAVELINOS WILSON AND FRAMER
ASSOCIATE ARCHITECTS
G 12
1 FRONT (NW) ELEVATION
2 REAR (SE) ELEVATION

PLATE NO. 2

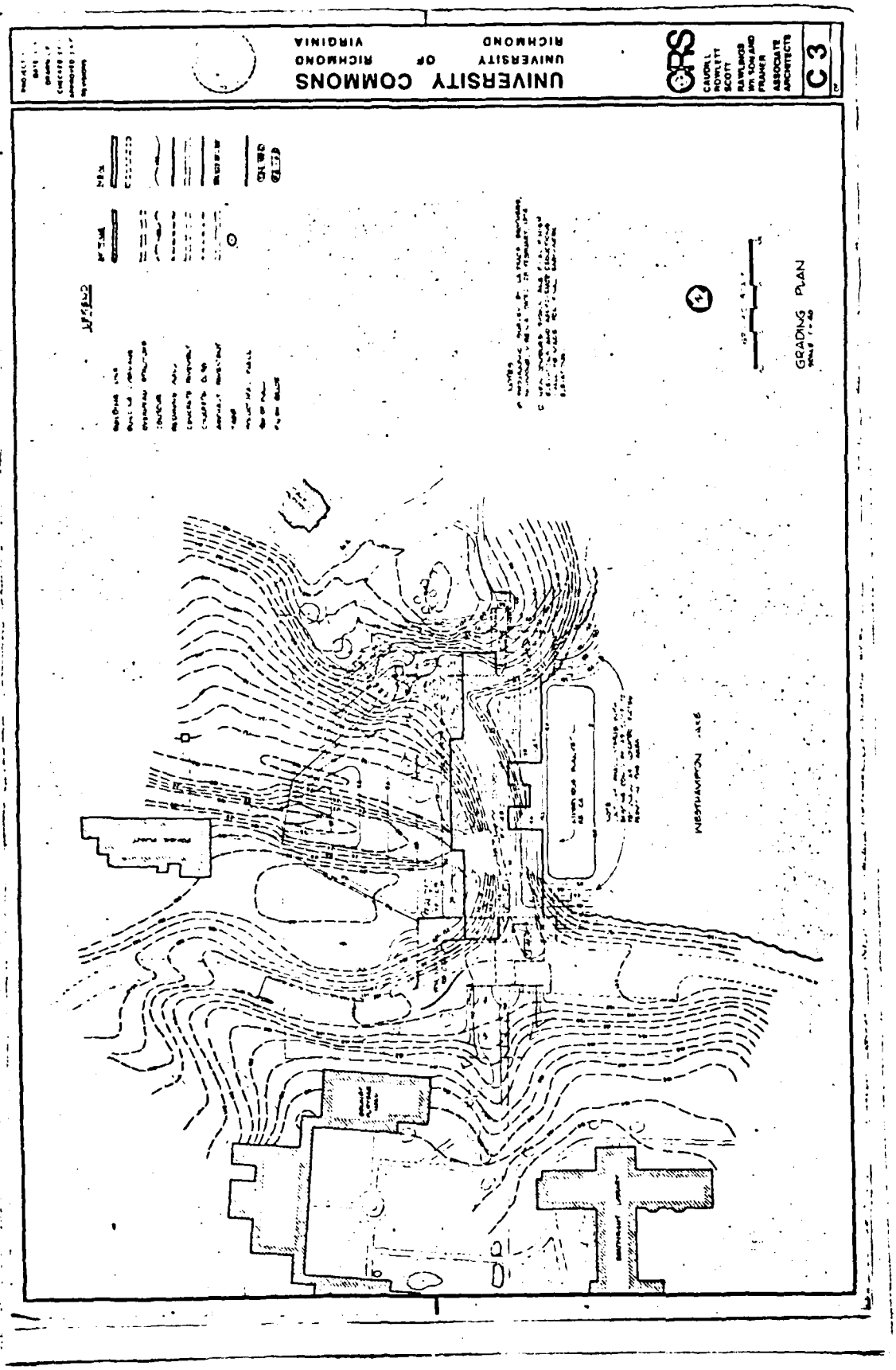

UNIVERSITY COMMONS
UNIVERSITY OF RICHMOND
RICHMOND VIRGINIA
CARROLL HOWLETT SCOTT RAWLINGS WILLIAM TOWARD PRIMER ASSOCIATE ARCHITECTS
C3
GRADING PLAN
WESTHAMPTON AVE

PLATE NO. 3

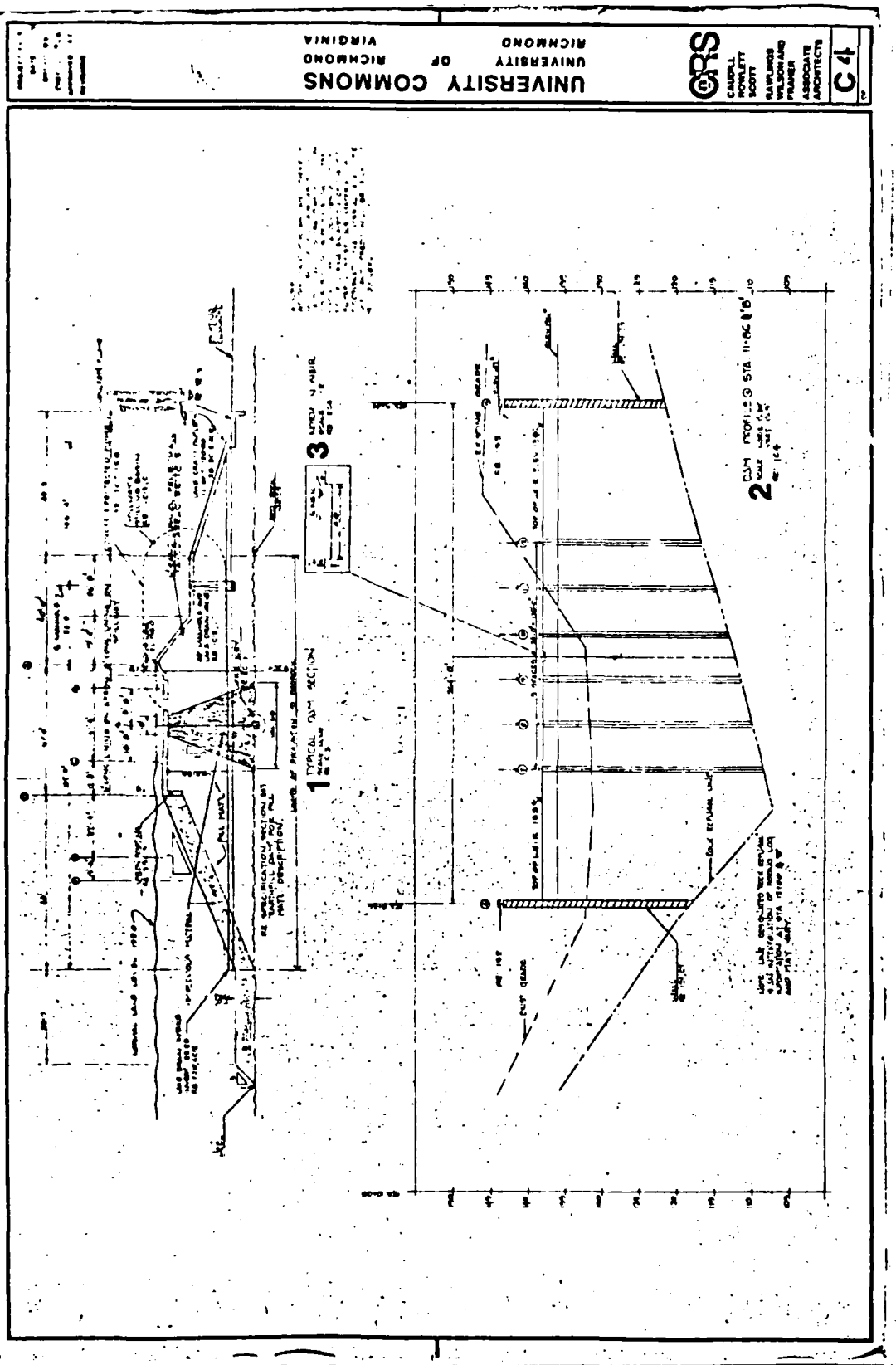
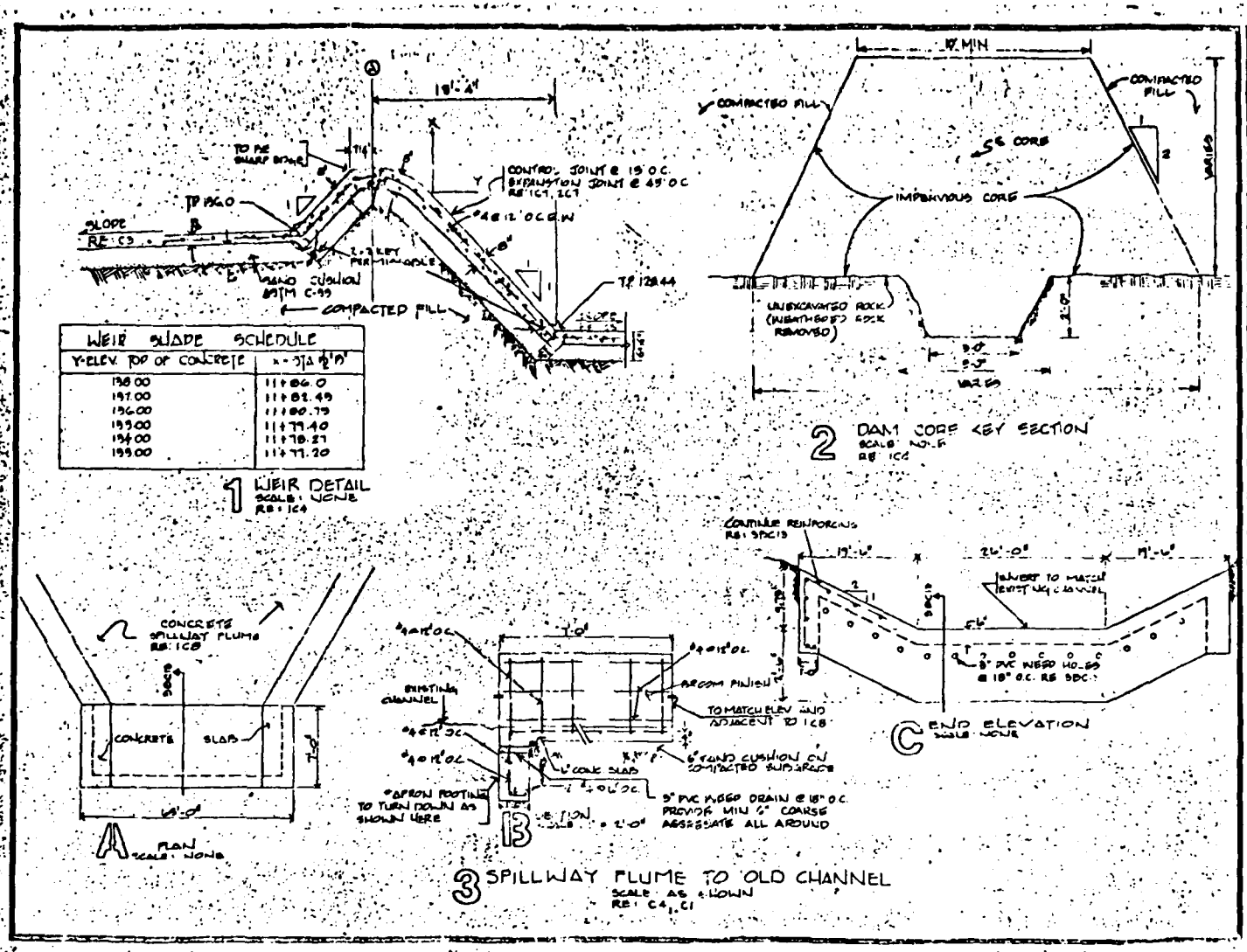

UNIVERSITY COMMONS
UNIVERSITY OF RICHMOND
RICHMOND VIRGINIA
CRS
CAUDILL ROWLETT SCOTT
RAFFLOOD WILSON AND FRAMES
ASSOCIATE ARCHITECTS
C4
1 TYPICAL DAM SECTION
2 DAM PROFILE @ STA 11+00 & 8+00
3

PLATE NO. 4

PLATE NO. 5



UNIVERSITY COMMONS
UNIVERSITY OF RICHMOND
RICHMOND VIRGINIA

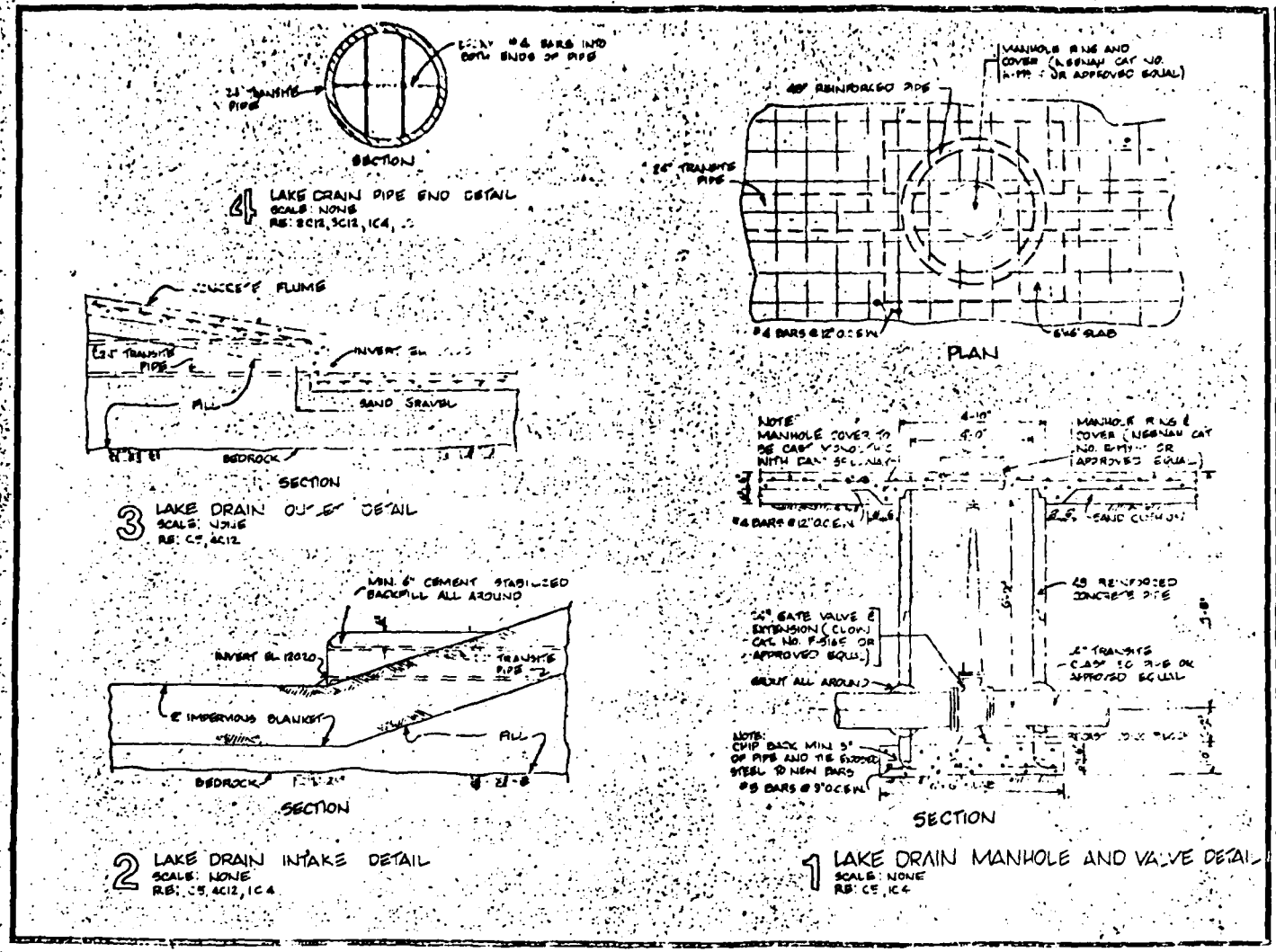
CRS
CAUDILL ROWLETT SCOTT

RAWLINGS WILSON AND FRAHER

ASSOCIATE ARCHITECTS

C13

PLATE NO. 6



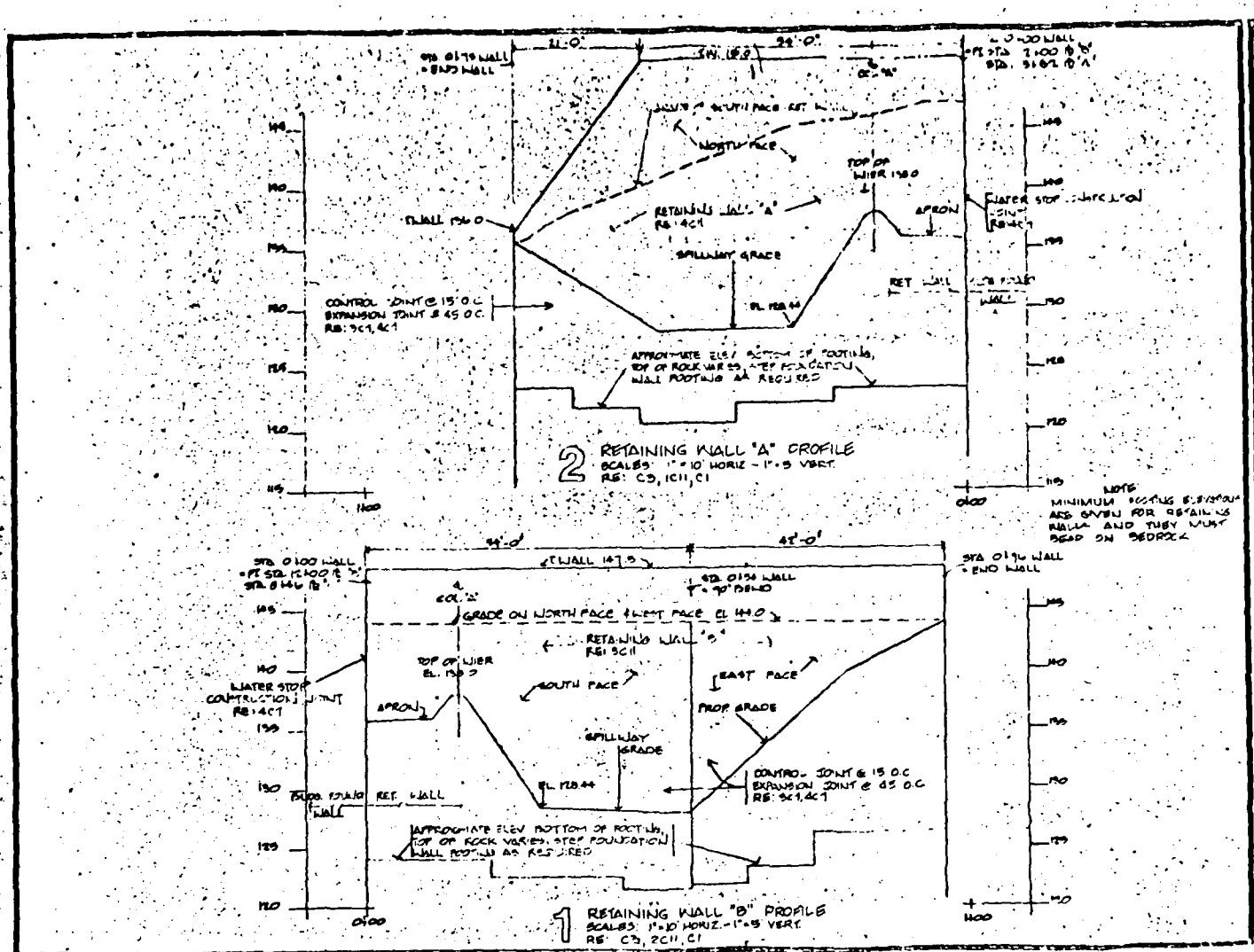
UNIVERSITY COMMONS
UNIVERSITY OF RICHMOND
RICHMOND VIRGINIA

CRS

CAUDILL ROWLETT SCOTT
RAWLINGS WILSON AND FRAHER
ASSOCIATE ARCHITECTS

C12

PLATE NO. 7

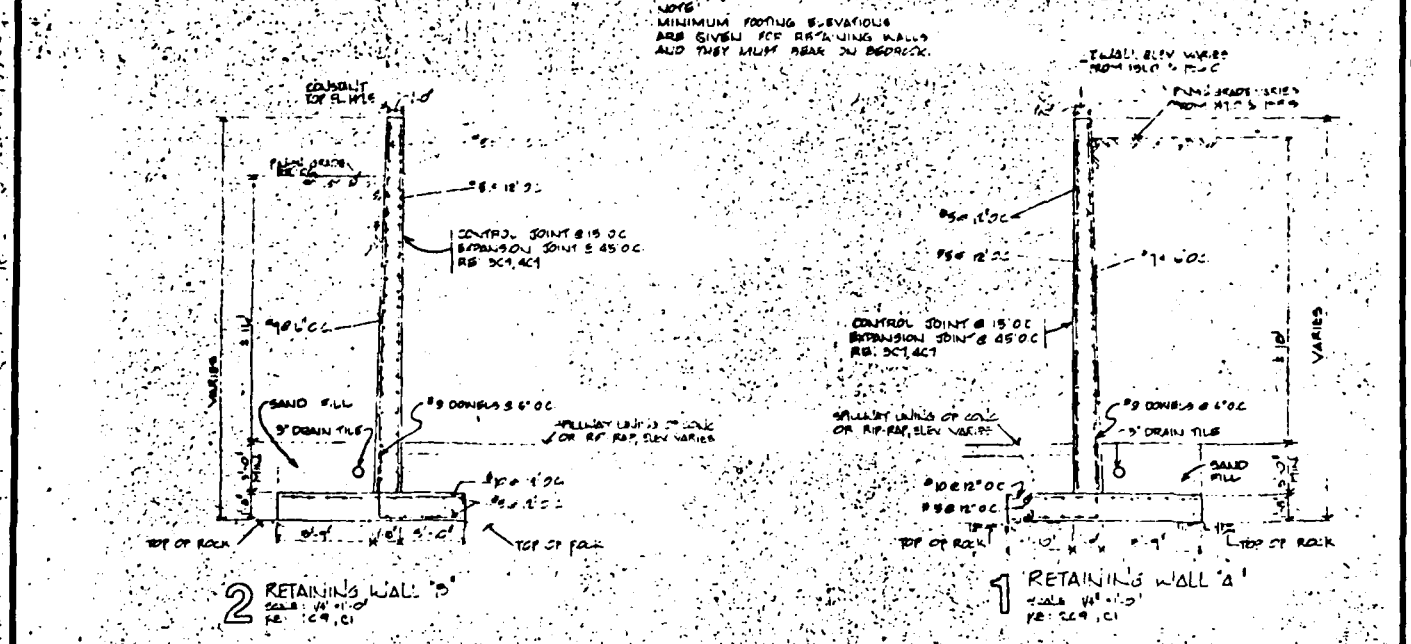


UNIVERSITY COMMONS
UNIVERSITY OF RICHMOND
RICHMOND VIRGINIA

CRSQ
CAUDILL ROWLETT SCOTT

RAWLINGS WILSON AND FRAHER
ASSOCIATE ARCHITECTS

PLATE NO. 8



UNIVERSITY COMMONS
UNIVERSITY OF RICHMOND
RICHMOND VIRGINIA

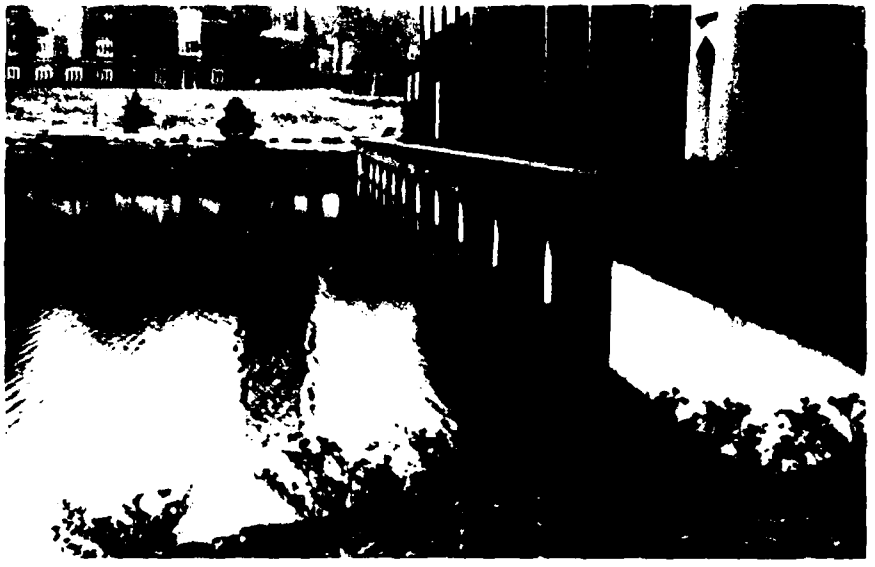
CRS
CAUDILL ROWLETT SCOTT

RAWLINGS WILSON AND FRAHER
ASSOCIATE ARCHITECTS

C 11

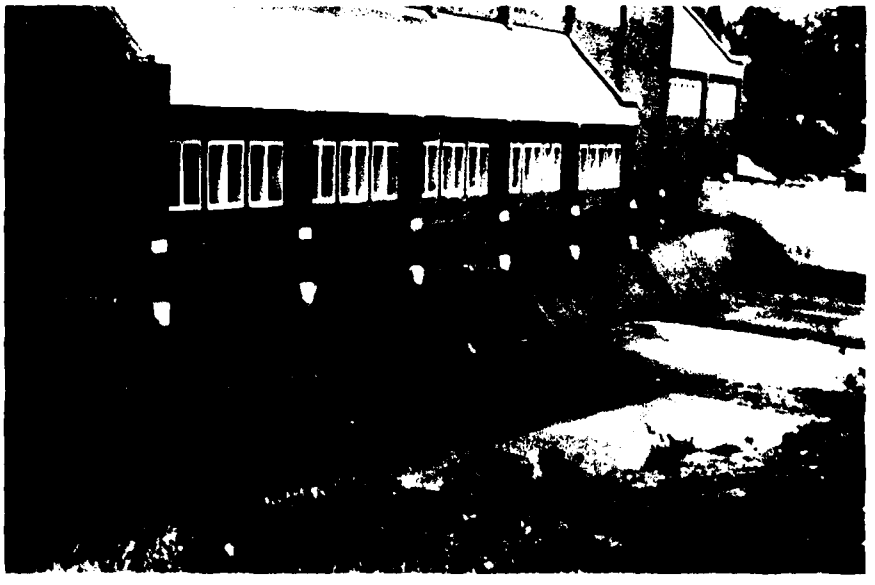
APPENDIX II

PHOTOGRAPHS



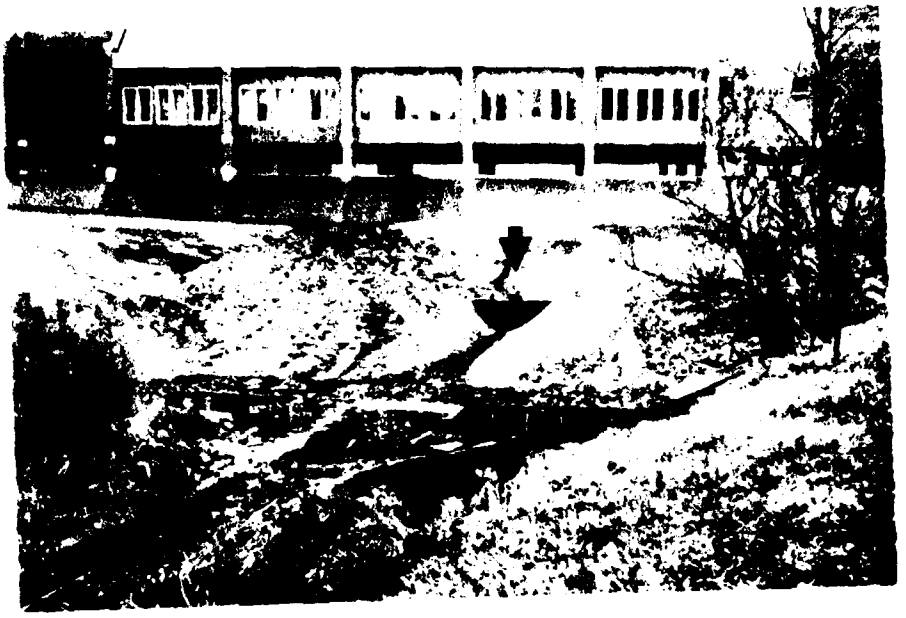
Upstream Face of Dam

Photo No. 1



Spillway and Downstream Face of Dam

Photo No. 2



Drain Pipe Outlet (arrow) and Approach Channel Clearance

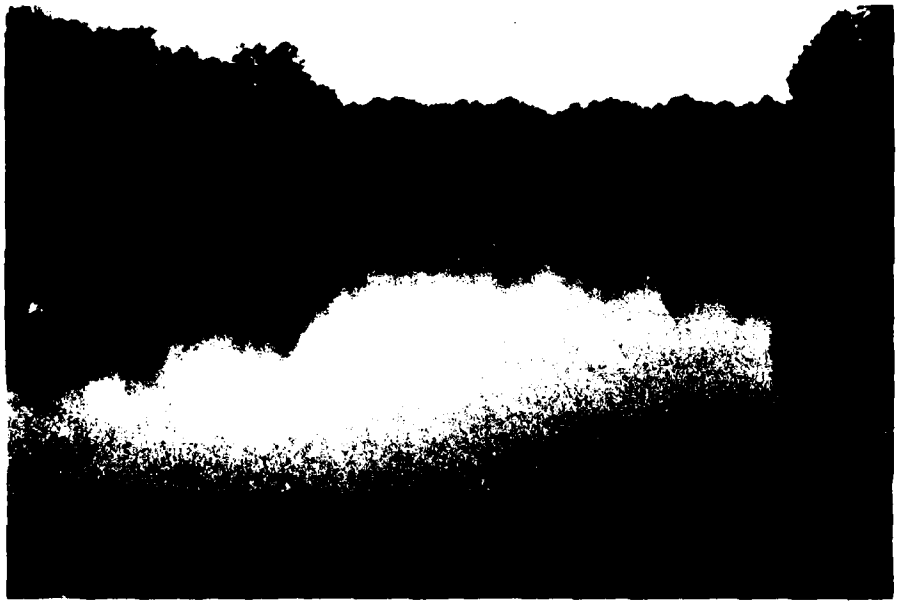
Photo No. 3

Downstream Channel

Photo No. 4

Approach Channel Under University Commons Building

Photo No. 5



Reservoir (Arrow Denotes Bridge).

Photo No. 6

APPENDIX III

FIELD OBSERVATIONS

Check List
Visual Inspection
Phase I

Name Dam University Commons City Richmond State Virginia Coordinators Lat 37° - 34.5' Long 77° - 32.3'

Date(s) Inspection November 17,1980 Weather Cloudy Light Rain Temperature 46°

Pool Elevation at Time of Inspection 137.75 msl Tailwater at Time of Inspection 120 msl

Inspection Personnel:

Schnabel Engineering Associates, P.C.

Raymond A. DeStephen, P.E.
Gilbert T. Seese
Gregory P. Adams
Stephen G. Werner

J. K. Timmons and Associates, Inc.

Robert G. Roop, P.E.

Owner Representative
Warden G. Farmer
Asst. Director of Physical Plant

State Water Control Board

Leon Musselwhite

Recorder:

Gilbert T. Seese

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	The downstream slope, crest and overflow spillway were covered with a concrete facing. Vertical cracks in the concrete facing on the steep portion (1H:1V)of the downstream slope between construction joints were observed. Horizontal hairline cracks in the concrete along the crest of the dam were observed. No surface cracks were observed in the abutment area inspected. Upstream slope of the dam was submerged and not observed.	The cracks should be inspected at regular intervals for increase in the number and size of the cracks.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No unusual movements or cracking were noted on the dam or downstream beyond the embankment toe.	None
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	No serious erosion was noted on the embankment as it is covered with a concrete facing on the crest and downstream slope. The downstream slope of the embankment is a 1H:1V slope from the crest at El 138 to El 128 then continues on a 17H:1V slope to El 120 at the stream channel. Some gullying erosion, approximately 1' x 1' was noted near the left upstream side of the abutment and along the right side slope of the spillway. The left abutment is located 36 ft behind a retaining wall and beneath the the Commons Building. The retaining wall at the right side of the spillway is part of the right abutment. The upstream abutments generally slope on 3H:1V or greater. See accompanying Field Sketch, Sheet 1.	None
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	The vertical and horizontal alignment of the dam appeared to be good.	None
RIPRAP FAILURES	Riprap was present at the downstream end of the discharge channel on the left side in an area previously eroded. See Field Sketch, Sheet 1.	None

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	The junction of the embankment and abutment was beneath the Commons Building and behind retaining walls. The walls were in good condition and no water was observed from the toe drains The upstream abutment areas were grass covered. The surface soils ranged from clayey silts (ML) to silty sands (SM) and for the most part are derived from in-place weathering of underlying bedrock. Fill material behind the retaining walls appeared to be clayey silts and silty sands with several large granitic boulders protruding from the fill slopes.	None
ANY NOTICEABLE SEEPAGE	Possible seepage was noted from several of the joints in the downstream concrete apron. See Sheet 1. This seepage was marked by discoloration of the concrete at the joints, indicated possible seepage through the embankment. Seepage was estimated at less than 1 gpm.	These seepage areas should be monitored For any increase in water condition such as the presence of fines in the water.
STAFF GAGE AND RECORDER	None observed.	Staff gage should be installed.
DRAINS	No internal drains observed within dam. Footing drains observed behind abutment retaining walls of spillway.	No flow observed.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE WEIR	Overflow concrete weir under the building 4 ft wide, low flow notch 3½" deep. No signs of concrete deterioration were observed.	Good Condition
APPROACH CHANNEL	Concrete building foundation. No noticeable cracking or spalling of concrete.	Good Condition
DISCHARGE CHANNEL	A large 30'-40' erosion scar which had been filled with riprap was located at the downstream end of the concrete apron on the left side. See accompanying Field Sketch, Sheet 1.	Repair is adequate
BRIDGE AND PIERS	Piers in spillway at 24 ft intervals for building foundation.	Piers in good condition

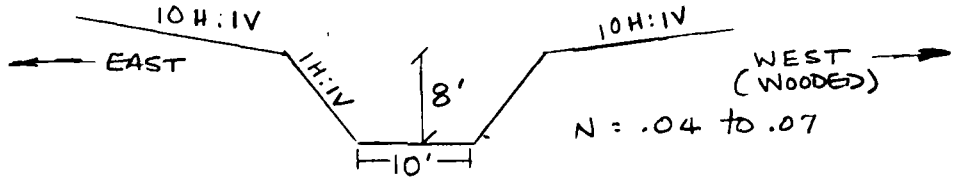
OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None	None
INTAKE STRUCTURE	None	None
OUTLET STRUCTURE	None	None
OUTLET CHANNEL	Concrete channel in good condition. Some minor cracking and seepage at construction joints.	Minor cracking appears to be shrinkage crack.
EMERGENCY DRAINS	According to Mr. Farmer, the emergency gate is in operational condition.	None

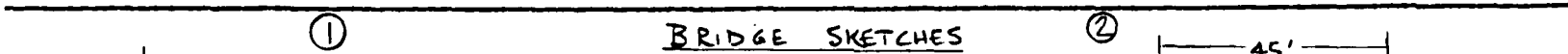
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Slopes on west side are 2H:1V± and mostly wooded. Slopes on east side are 4H:1V± and grass covered. A wooden footbridge crosses the reservoir at the upper end.	Surrounding slopes are well maintained.
SEDIMENTATION	Sedimentation was removed when dam was rebuilt in 1976. No noticeable sediment buildup during the inspection.	None

DOWNSTREAM CHANNEL

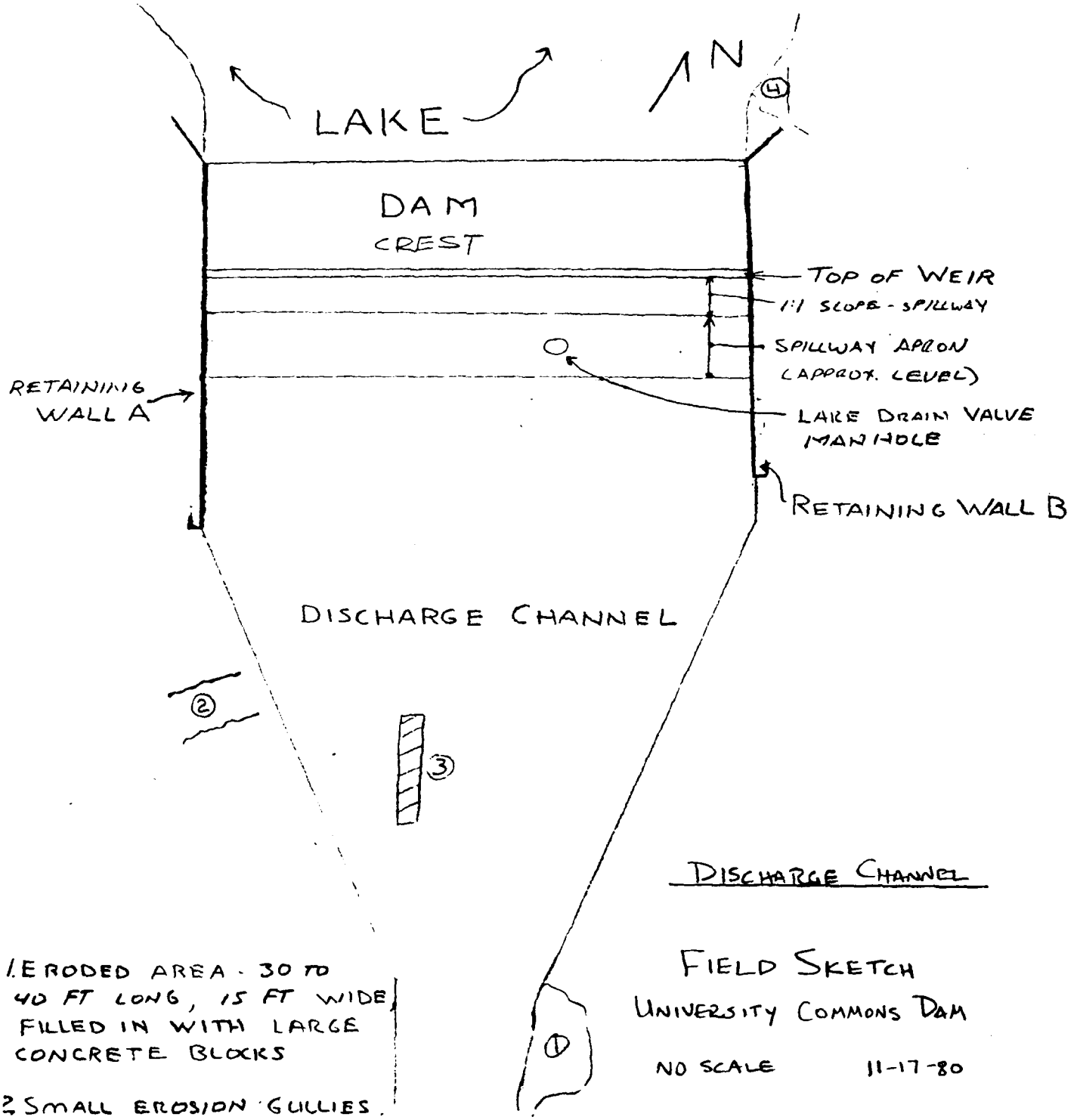
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Clear channel with some vegetation on west side. Two bridges below the dam 500 ft±. See sketch below.	None
SLOPES		
APPROXIMATE NO. OF HOMES AND POPULATION	1. Power plant location 100 ft below outlet channel 2. Warehouse facility 500 ft downstream. 3. Construction office 500 ft downstream	Potential hazard if dam fails.

BRIDGE SKETCHES



INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	None
OBSERVATION WELLS	None	None
WEIRS	None	None
PIEZOMETERS	None	None
OTHER	None	None



DISCHARGE CHANNEL

FIELD SKETCH
UNIVERSITY COMMONS DAM

NO SCALE 11-17-80

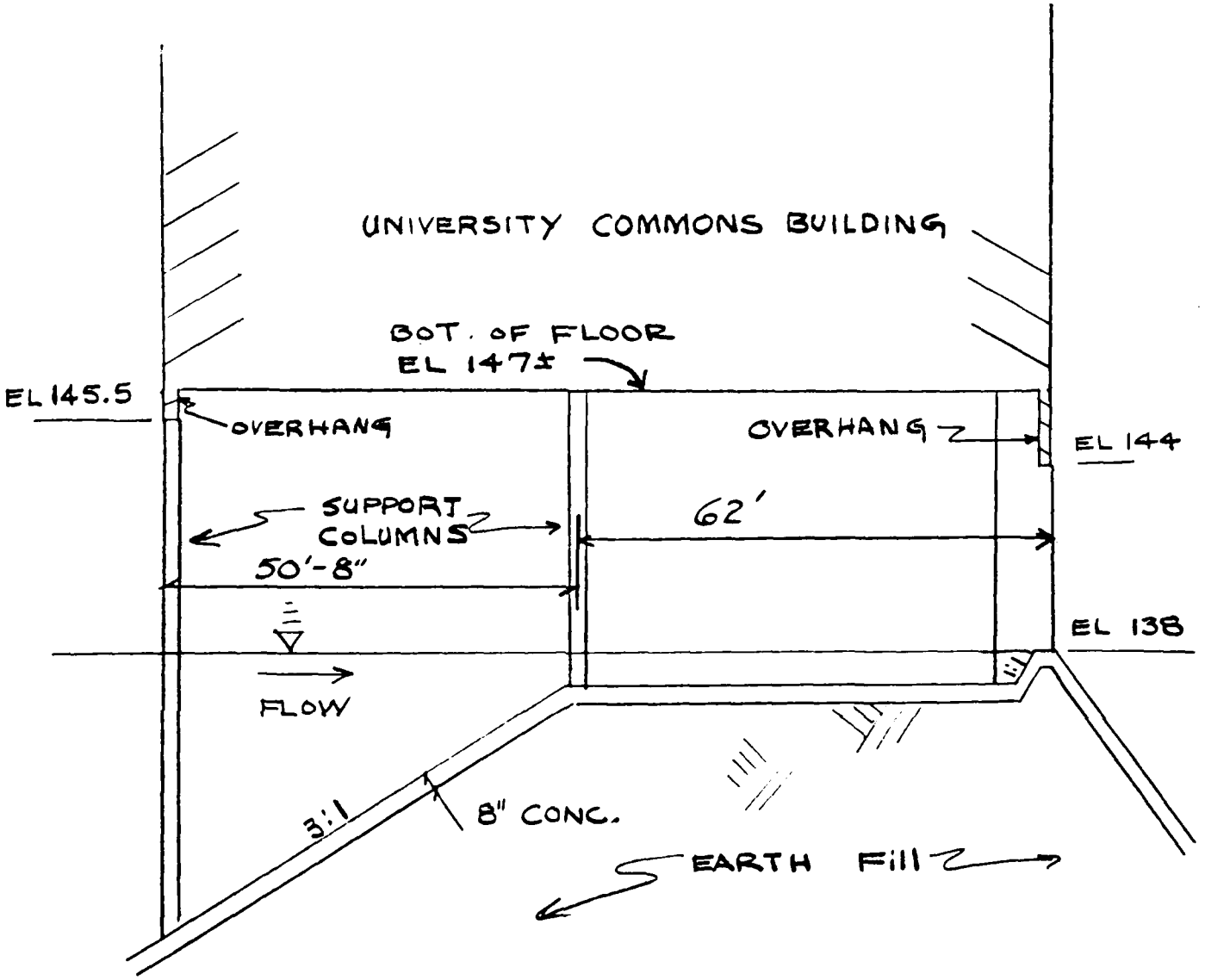
SHEET 1

1. ERODED AREA - 30 TO 40 FT LONG, 15 FT WIDE FILLED IN WITH LARGE CONCRETE BLOCKS

2. SMALL EROSION GULLIES 1FT x 3FT, ALONG CHANNEL SIDE SLOPES

3 SEEPAGE FROM CONSTRUCTION JOINTS IN CONCRETE MEMBRANE APPROXIMATELY 80FT DOWNSTREAM FROM SPILLWAY.

4 SMALL EROSION GULLIES 1FT x 2FT LEFT UPSTREAM ABUTMENT.



SECTION THROUGH DAM & BUILDING

FIELD SKETCH

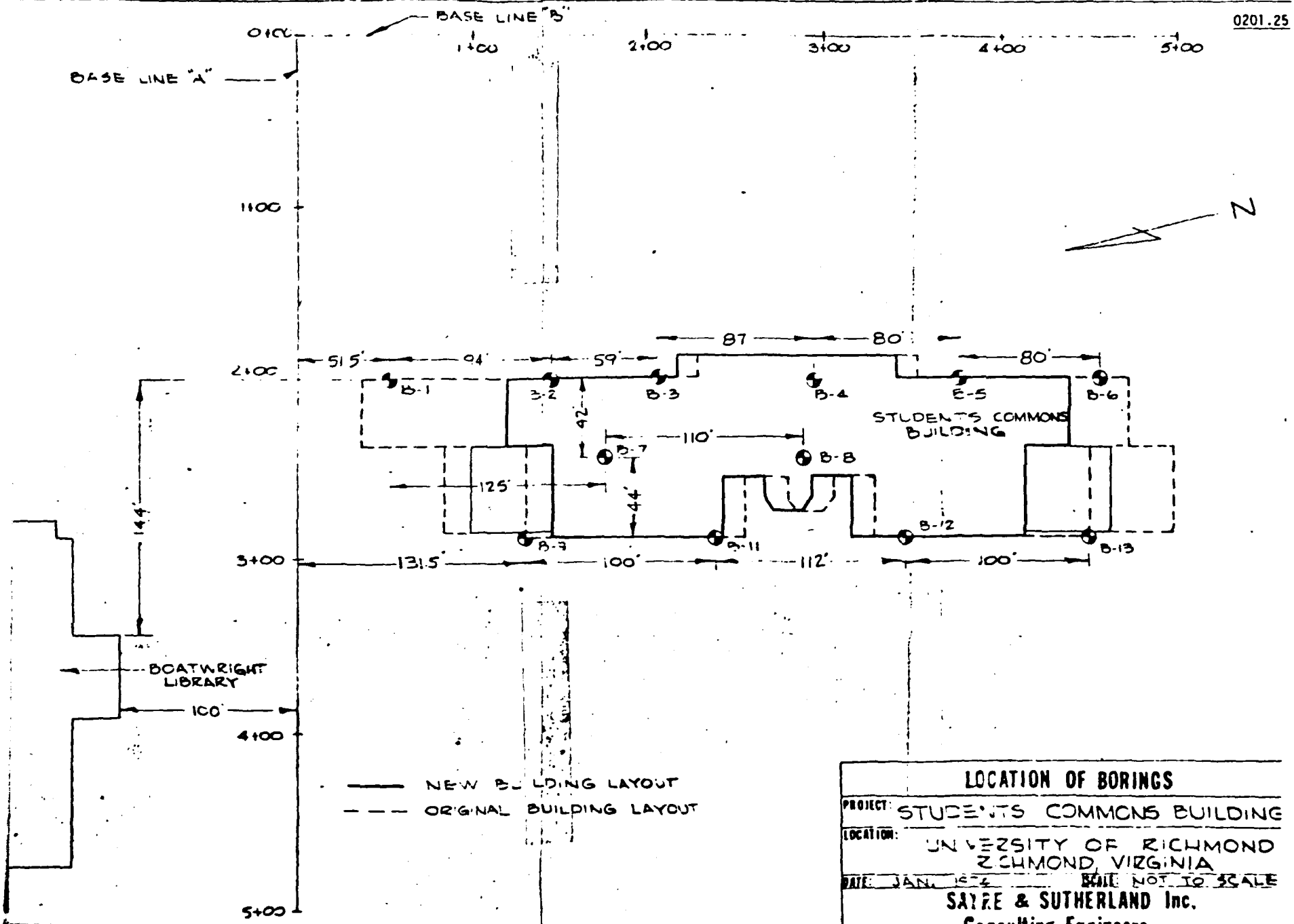
UNIVERSITY COMMONS DAM

NO SCALE 11-17-80

SHEET 2

APPENDIX IV

TEST BORING LOGS



LOCATION OF BORINGS

PROJECT: STUDENTS COMMONS BUILDING

LOCATION: UNIVERSITY OF RICHMOND
RICHMOND, VIRGINIA

DATE: JAN. 1964 SCALE: NOT TO SCALE

SAYRE & SUTHERLAND Inc.
Consulting Engineers

Hole No. 1

0201.11

[illegible]	[illegible]	DESCRIPTION	N*	REMARKS
144.6	0.0			
144.1	0.3	Topsoil		Water Data:
		Brown sandy CLAY, possible		5.5 ft. below surface
141.4	3.0	fill	8	at completion
		Red clayey SILT, trace of mica		
140.4	4.0		25	
		Brown silty SAND, residual		
136.4	8.0			50/0.0
		Refusal		
				Boring Contractor:
				Ayers & Ayers, Inc.

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer falling 30

[illegible]: Student Commons Building
University of Richmond
Richmond, Virginia

Date: January 11, 1974

SANDS & SUTHERLAND Inc.
Consulting Engineers
RICHMOND, VIRGINIA

Hole No. 2 0201.12

Elevation	Depth	DESCRIPTION	N*	REMARKS
132.8	0.0			
132.6	0.2	Topsoil		Water Data: 6.5 ft. below surface after 24 hours
		Soil, cinders, organic matter, brick FILL	15	
			11	
125.8	7.0			94/.85
125.0	7.8	Gray silty SAND, residual		Started core drilling rock at 7.8 ft.
		Gray GRANITE 100% core recovery - solid		
122.5	10.3	Gray GRANITE 100% core recovery - solid		
120.0	12.8	Boring Terminated		Boring Contractor: Ayers & Ayers, Inc.

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer falling 30"

PROJECT: Student Commons Building
University of Richmond
Richmond, Virginia

SAVRE & SUTHERLAND Inc.
Consulting Engineers
RICHMOND, VIRGINIA

Hole No. 3

0201.13

Elevation	Depth	DESCRIPTION	N*	REMARKS
131.4	0.0			
131.2	0.2	Topsoil		Water Data: 6.4 ft. below surface at completion
		Brown sandy silty clay	18	
		FILL	2	
			2	
			WOR	Weight of drill rod
118.4	13.0	Brown silty coarse SAND, residual		
117.1	14.3			100/0.3
		Gray GRANITE, slightly weathered, fractured		Started core drilling rock at 14.3 ft.
		100% core recovery		
112.5	18.9	Gray GRANITE, some weathering, fractured		
		92% core recovery		
107.5	23.9	Boring Terminated		
				Boring Contractor: Ayers & Ayers, Inc.

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer falling 3

PROJECT: Student Commons Building
University of Richmond
Richmond, Virginia

SAYRE & SUTHERLAND Inc.
Consulting Engineers
RICHMOND VIRGINIA

Hole No. 4

0201.14

Elevation	Depth	DESCRIPTION	N*	REMARKS
132.6	0.0			
132.4	0.2	Topsoil		Water Data: 13.3 ft. below surface at completion
		Brown sandy clay FILL	5	
130.1	2.5			
129.9	2.7	Organic Matter		
			5	
		Red silty clay, some sand, FILL		
123.1	9.5		26	Hit large gravel
		Gray silty coarse SAND, residual		
118.5	14.1			50/0.1
		Gray decomposed GRANITE 17.6% core recovery		Started core drilling rock at 14.1 ft.
115.1	17.5			
		Gray GRANITE, broken 100% core recovery		
112.6	20.0			
		Boring Terminated		Boring Contractor: Ayers & Ayers, Inc.

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer falling 30"

PROJECT: Student Commons Building
University of Richmond
Richmond, Virginia

DATE: January 14, 1974

SAYRE & SUTHERLAND Inc.
Consulting Engineers
RICHMOND, VIRGINIA

Hole No. 5

0201.

Elevation	Depth	DESCRIPTION	N*	REMARKS
146.4	0.0			
146.3	0.1	— Bituminous surface treatment —		
144.9	1.5	Crushed Rock		Water Data: 15.2 ft. below surfa before coring
		Brown clayey silt, some mica, FILL	16	
		1/2" layer of cinders at 4.5 ft.	19	
			13	
132.6	13.8			
		Gray silty fine SAND, residual	91	
128.4	18.0			
		Brown fine sandy SILT, some mica, residual	59	
123.8	22.6			50/0.05 Started core drilling rock at 22.6 ft.
		Gray GRANITE, fractured 100% core recovery		
118.8	27.6			
		Boring Terminated		
				Boring Contractor: Ayers & Ayers, Inc.

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer fall

PROJECT: Student Commons Building
University of Richmond
Richmond, Virginia

SAYRE & SUTHERLAND In
Consulting Engineers
RICHMOND, VIRGINIA

DATE: January 15, 1974

Hole No. 7

0201.1

Elevation	Depth	DESCRIPTION	N*	REMARKS
146.1	0.0			
146.0	0.1	Asphalt pavement		
145.1	1.0	Crushed rock		Water Data: 13 ft. below surface at completion
		Brown silt, thin seams of organic soil, FILL	9	
			12	
			6	
133.1	13.0			
		Gray silty SAND and decomposed rock fragments, residual		100/0.9
130.9	15.2			100/.05
		Refusal		
				Boring Contractor: Ayers & Ayers, Inc.

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer falling

PROJECT: Student Commons Building
University of Richmond
Richmond, Virginia

SAYRE & SUTHERLAND Inc.
Consulting Engineers
RICHMOND, VIRGINIA

Boring No. 7A (con't)

0201.19

Elevation	Depth	DESCRIPTION	N*	REMARKS
106.1	40.0	Gray, hard, coarse-grained GRANITE, moderately fractured 100% core recovery		
103.7	42.4	Note		Note: Gray, hard, coarse-grained GRANITE, moderately fractured 100% core recovery
102.1	44.0	Boring Terminated		

Boring Contractor:
Ayers & Ayers, Inc.

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer falling 3

PROJECT: Student Commons Building
University of Richmond
Richmond, Virginia

SAYRE & SUTHERLAND Inc.
Consulting Engineers

Hole No. 7A

0201.18

Elevation	Depth	DESCRIPTION	N*	REMARKS
146.1	0.0			
145.9	0.2	Asphalt pavement		
145.1	1.0	Crushed rock		Note: Boring 7A offset 10 feet from Boring 7
		Brown silt, thin seams of organic soil, FILL		Water Data: 13.5 ft. below surface at completion
			6	
130.1	16.0			
		Gray silty SAND, residual		85/0.1
128.5	17.6			Core drilled rock from 17.6 ft. to 22.7 ft.
		Tan, moderately hard, coarse grained GRANITE, moderately weathered; decomposed seam at 18.5 ft. to 18.6 ft.		
123.4	22.7	78% core recovery		
		Brown silty SAND, decomposed rock	65	
			52	
119.9	26.2			Started core drilling rock again at 26.2 ft.
119.6	26.5	Note		
		Brown silty SAND & weathered rock fragments 100% core recovery		Note: From 26.2 ft. to 26.5 ft. Tan clayey SILT
117.9	28.2			
		Brown silty SAND & weathered rock fragments		
		18% core recovery		
112.9	33.2			
		Brown silty SAND & weathered rock fragments		
		52% core recovery		
108.7	37.4			
		(See next sheet)		

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer falling

PROJECT: Student Commons Building
University of Richmond
Richmond, Virginia

SAYRE & SUTHERLAND Inc.
Consulting Engineers
RICHMOND, VIRGINIA

DATE: January 16, 1974

Hole No. 8

0201.20

Elevation	Depth	DESCRIPTION	N*	REMARKS
146.3	0.0			
146.2	0.1	Asphalt pavement		Water Data:
144.8	1.5	Crushed rock		13 ft. below surface at completion
		Brown silt, occasional organic matter, FILL	7	
			10	
			4	
			8	
128.3	18.0			
		Gray silty CLAY, layer of organic (original topsoil)	8	
122.3	24.0			
		Gray silty SAND, trace of organic, saturated (stream deposit)	5	
119.3	27.0			
		Gray silty SAND and decomposed rock		100/0.2
117.1	29.2			
		Refusal		Boring Contractor: Ayers & Ayers, Inc.

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer falling 30"

PROJECT: Student Commons Building
University of Richmond
Richmond, Virginia

DATE: January 17 1974

SAYRE & SUTHERLAND Inc.
Consulting Engineers
RICHMOND, VIRGINIA

Hole No. 9

0201.21

Elevation	Depth	DESCRIPTION	N*	REMARKS
145.7	0.0			
145.5	0.2	Asphalt pavement		
144.2	1.5	Crushed rock		Water Data: 14.8 ft. below surface at completion
		Brown sandy clay, some sand and gravel, traces of organic matter, FILL	12	
			18	
138.7	7.0	Brown silty SAND, residual		
			15	
131.7	14.0	Brown fine sandy SILT, residual	36	
			82	
				100/0.2
119.7	26.2	Refusal		100/0.2

Boring Contractor: Ayers & Ayers, Inc.

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer falling 30"

PROJECT: Student Commons Building
University of Richmond
Richmond, Virginia

DATE: January 15, 1974

SAYRE & SUTHERLAND Inc.
Consulting Engineers
RICHMOND, VIRGINIA

Hole No. 11

0201.22

Elevation	Depth	DESCRIPTION	N*	REMARKS
138.0	0.0			
		WATER		
130.0	8.0			
129.5	8.5	Black organic MUCK	PUSH	
		Gray sandy CLAY and fine to medium SAND, trace of organic	3	
			9	
119.5	18.5	Gray decomposed rock		
116.5	21.5		100/0.3	
114.7	23.3	Gray moderately weathered to hard GRANITE 94% core recovery		Started core drilling rock at 21.5 ft.
111.7	26.3	Gray GRANITE, fractured 98% core recovery		
		Boring Terminated		

Boring Contractor:
Ayers & Ayers, Inc.

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer falling 30

PROJECT: Student Commons Building
University of Richmond
Richmond, Virginia

SAYRE & SUTHERLAND Inc.
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RICHMOND, VIRGINIA

Elevation	Depth	DESCRIPTION	N*	REMARKS
138.0	0.0			
		WATER		
125.0	13.0			
		Gray CLAY, some sand lenses, trace of organic matter	PUSH	
119.4	18.6			1/0.6 then 37/0.4
118.5	19.5	Gray silty SAND, residual		19.3 100/0.2
		Gray GRANITE, badly broken 100% core recovery		Started core drilling rock at 19.5 ft.
113.5	24.5			
		Boring Terminated		
				Boring Contractor: Ayers & Ayers, Inc.

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer falling 30

PROJECT: Student Commons Building
University of Richmond
Richmond, Virginia

DATE: January 23, 1974

SAYRE & SUTHERLAND Inc.
Consulting Engineers
RICHMOND, VIRGINIA

Hole No. 13

0201.24

Elevation	Depth	DESCRIPTION	N*	REMARKS
145.0	0.0			
144.7	0.3	Asphalt pavement		
		Brown SAND and CLAY		Water Data:
			13	7.3 ft. below surface
142.0	3.0			after 2 hours
		Brown silty SAND, residual	16	
136.0	9.0			
		Gray silty SAND, residual	40	
132.5	12.5			100/.05
		Refusal		

Boring Contractor:
Ayers & Ayers, Inc.

*N= Blows per foot on 2" OD, 1-3/8" ID sampling spoon with 140 lb hammer falling 30"

PROJECT: Student Commons Building
University of Richmond
Richmond, Virginia

SAYRE & SUTHERLAND Inc.
Consulting Engineers
RICHMOND, VIRGINIA

APPENDIX V - REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Department of Army, Office of the Chief of Engineers, 46 pp.
2. Design of Small Dams, U. S. Department of Interior, Bureau of Reclamation, 1974, 816 pp.
3. Geology of the Studley, Yellow Tavern, Richmond and Seven Pines Quadrangles, Virginia: 1974 P. A. Daniles, Jr. and Emil Onuschak, Jr., Virginia Division of Mineral Resources Rept. Inv. 38, 75pp.
4. Geology of the Bon Air Quadrangle, Virginia by Bruce K. Goodwin, Virginia Division of Mineral Resrouces, Publication 18, 1 pp.
5. HEC-1 Dam Break Version, Flood Hydrograph Package, Users Manual for Dam Safety Investigations, the Hydrologic Engineering Center, U. S. Army Corps of Engineers, September, 1978.
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